# Furnished cage system and hen well-being: Comparative effects of furnished cages and battery cages on behavioral exhibitions in White Leghorn chickens

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**ABSTRACT** The battery cage system is being banned in the European Union before or by 2012, and the furnished cage system will be the only cage system allowed after 2012. This study was conducted to examine the different effects of caging systems, furnished cages vs. battery cages, on bird behaviors. One hundred ninety-two 1-d-old non-beak-trimmed Hy-Line W-36 White Leghorn chicks were reared using standard management practices in raised wire cages. At 19 wk of age, the birds were randomly assigned into battery cages or furnished cages. The battery cages were commercial wire cages containing 6 birds per cage, providing 645 $cm^2$ of floor space per birds. The furnished cages had wire floors and solid metal walls, with perches, a dustbathing area, scratch pads, and a nestbox area with a concealment curtain. Based on the company recommendations, 10 birds were housed per cage, providing a stocking density of 610 $cm^2$ of floor space per bird. Behavioral observations were conducted using the Noldus Observer software package. The birds were observed at 5-min intervals for the entire light period. The birds housed in battery cages had higher posture and behavioral transitions and increased time spent walking and performing exploratory behavior ($P < 0.05$, 0.01, respectively), which may indicate they were stressed, resulting in restlessness, whereas the birds housed in furnished cages had higher levels of preening ($P < 0.05$). Preening has been considered as a comfort behavior in birds. These results may suggest that furnished cages may be a favorable alternative system for housing birds by allowing them to perform certain natural behaviors.

**Key words:** furnished cage, battery cage, behavior, chicken, well-being

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## INTRODUCTION

Chickens are social animals and live in a small group in nature. They spend a lot of time scratching and foraging for food on the ground and perform heritable behaviors such as dustbathing and prelaying nesting. In the commercial poultry industry, in the United States and globally, layers are primarily housed in battery cages (also called conventional cages). Worldwide, battery cage systems elicit a great deal of debate pertaining to the relative effect of the practice on bird well-being (Dawkins et al., 2004). The bestowed benefits are of maintaining a small group size, with a low level of social stress, resulting in low aggression and cannibalism, high egg production, and increased hygiene, which may indeed favor improved well-being in caged birds (Appleby, 1998). In addition, economically, battery cages are highly efficient because large numbers of birds can be housed in strict confinement with highly mechanized feed and water systems, with manure and eggs collected automatically (Cooper and Albentosa, 2003). In this case, battery cages benefit both the birds and producers. However, there is considerable morphological, physiological, and behavioral evidence demonstrating stress reactions in chickens reared in the battery cage systems because there are no significant changes in birds' biological and behavioral characteristics through selectively breeding for egg productivity (Folsch and Vestergaard, 1981; Rogers, 1995). Domestic birds may still prefer to perform certain natural behaviors; however, within the battery cages, the birds' behavior repertoire is restricted and bone quality is reduced by the overcrowding and barren environment (Hughes et al., 1993; Baxter, 1994; Fleming et al., 1994; Nicol, 1995; Vestergaard et al., 1997; Tauson, 1998). Because of those effects, there is growing pressure from animal well-being and consumer groups advocating the banning of battery cage systems in the poultry industry. Similar lobbying by layperson organizations within Europe has lead to the introduction of legislation to ban battery cages on January 1, 2012 (CEC, 1998, 1999).


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In the United States, legislative actions attempting to regulate poultry practices have been initiated in several states (e.g., California, Illinois, and Washington). Similarly, several fast-food restaurant chains, including McDonalds, Burger King, and Kentucky Fried Chicken, have acted by implementing written welfare guidelines that their egg suppliers are expected to adhere to. The US poultry industry is in prime position to preempt and influence any future legislation to ban or restrict battery cages by evaluating and implementing more welfare-friendly housing systems for minimizing stress yet safeguarding bird well-being.

Currently, researchers are examining various housing systems, such as deep-littered housing, aviaries, floor pens, get-away cages, free-range, and furnished cages and quantifying the effect on the welfare of birds housed in those environments (Hansen, 1994; Cunningham and Mauldin, 1996; Dawkins et al., 2004; Tauson, 2004; Hester, 2005; Mertens et al., 2006). Among the alternatives, furnished (also called enriched) cage systems may offer a more suitable housing system for both improving well-being for birds and maintaining profile for producers (FAWC, 2007). Furnished cages attempt to provide enrichment to birds while still taking advantage of the benefits of a small group size. The cages are equipped with perches, dustbaths, and nesting areas allowing the birds to meet the needs for their natural behaviors, such as nesting, roosting, and scratching (Lindberg and Nicol, 1997; Newberry, 1999; Cordiner and Savory, 2000). Previous studies have shown that birds housed in the furnished cages also improve well-being by reducing fear, aggression, and feather pecking and increasing bone mineral density (Gvaryahu et al., 1994; Newberry, 1995; Kopka et al., 2003). Although furnished cage systems seem to be a possible way for improving bird well-being, its influences have been shown to be strain-, age-, and facility-dependent. Before recommending its widespread use within the egg industry, a full-scale scientific evaluation of its purposed benefits needs to be conducted, especially in White Leghorn birds, which are the major egg-producing birds in the United States.

Behavioral changes in animals, including birds, have been used as reliable well-being indicators in evaluating the capability of an animal to adapt to stimulations (Dawkins, 1999). The objective of this study was to determine the effects of furnished cages versus battery cages on birds' behavioral response to the environmental stimulations and to evaluate how these changes affect bird well-being.

## MATERIALS AND METHODS

### Chickens and Housing Systems

One hundred ninety-two 1-d-old non-beak-trimmed Hy-Line W-36 White Leghorn chicks were reared using standard management practices in raised wire cage. At 19 wk of age, the birds were randomly assigned into 2 different housing treatments: battery cages and furnished cages (n = 12/treatment). Based on the company recommendations, 10 birds were housed per cage, providing a stocking density of 610 cm$^2$ of floor space/bird, without counting nestbox and dustbathing areas (i.e., 120 × 55 × 45 cm; length × width × height). The furnished cages (EV 550-EU, Big Dutchman, Vechta, Germany) had wire floors with solid metal walls and included perches arranged in front of the litter bath, a dustbathing area located at the left rear corner, scratch pads behind the feed trough, and a nestbox area with a concealment curtain located at the right rear corner. Sand was used as dustbathing substrate. The birds can access the facilities without restriction. For comparison, attempts were made to use a comparable stocking density in the battery cages. The battery cages were commercial wire cages containing 6 birds per cage, providing 645 cm$^2$ of floor space/bird (i.e., 102 × 38 × 46 cm; length × width × height). Feed and water were provided ad libitum to both treatments. Overhead lights were on a 16L:8D schedule, from 0700 to 2300 h. Both housing treatments were located within the same room at Purdue University Poultry Farm.

Daily inspections were conducted by Poultry Unit staff to observe for body injury and mortality. The birds were also inspected weekly for incidence of bumblefoot and severe feather-pecking injuries. The experimental protocols were approved by the Institutional Animal Care and Use Committee at Purdue University.

### Behavioral Observation Analysis

Video cameras were set up at the poultry farm and the bird behaviors were videotaped for an entire light period before blood collection at 30, 40, and 50 wk of age (blood samples were used for another analysis). Behavioral observations were conducted using the Noldus Observer software package (Mindware Technologies Ltd., Gahanna, OH). The birds were observed at 5-min intervals for the entire light period. At every 5-min interval, the number of birds in each area of the cage (cage floor, perch, dustbath, nestbox), number of birds in each body position (stand, sit, unable to see), and number of birds performing each behavior (feed, drink, walk, preening, exploratory pecking, and inactive) were documented. All behavior analysis was carried out by the same person experienced in observing and analyzing poultry behavior.

### Statistical Analysis

Data were analyzed using a GLM in SAS Version 8.0 (SAS Institute Inc., Cary, NC). Model statements for data analysis included age, housing treatment, and the interaction between age and treatment. Data were tested for normality and corrected for normality if necessary, dependent on individual data sets. Where sig-

**Table 1.** Effects of housing conditions, battery cages versus furnished cages, on frequency of posture states in laying hens[1]

| | Battery cages | | | Furnished cages | | |
|---|---|---|---|---|---|---|
| Postures | 30 wk | 40 wk | 50 wk | 30 wk | 40 wk | 50 wk |
| Stand | $82.9 \pm 2.6^{B}$ | $84.9 \pm 4.9$ | $85.8 \pm 3.4$ | $93.0 \pm 2.9^{A}$ | $83.9 \pm 3.9$ | $85.8 \pm 3.8$ |
| Sit | $17.1 \pm 2.6^{A}$ | $15.5 \pm 4.9$ | $14.3 \pm 3.4$ | $6.2 \pm 2.9^{C}$ | $10.7 \pm 3.9$ | $15.1 \pm 3.8$ |
| Posture transition index | $6.9 \pm 0.9^{A}$ | $5.3 \pm 0.8$ | $7.2 \pm 1.1$ | $3.8 \pm 1.0^{B}$ | $6.0 \pm 0.8$ | $7.0 \pm 0.5$ |

$^{A,B;\,A,C}$Significant difference between the battery and furnished cage systems ($^{A,B}P < 0.05$; $^{A,C}P < 0.01$).

[1]Data are presented as mean ± SE (n = 12).

nificant $F$-values were noted, appropriate post hoc tests (turkeys) were performed to determine where these differences lay. A significant difference was at $P < 0.05$.

## RESULTS

### Bird Health

One bird housed in a battery cage died during the experiment. One bird housed in a furnished cage had a feed impaction on the side of its beak, which was treated with Nolvosan (Fort Dodge Labs, Fort Dodge, IA) and healed. Six birds housed in furnished cages, but none in battery cages, had bumblefoot, which was treated with triple antibiotic ointment and healed. No feather pecking was seen during behavior observations. Therefore, no hens were found to be injured from feather pecking.

### Posture (Standing and Sitting)

There was no housing effect on frequency of standing or sitting except at 30 wk of age. At 30 wk of age, the birds housed in the furnished cages spent more time standing than those housed in battery cages (Table 1, $P < 0.05$). Consistently, posture transition index (recorded as the number of changes between sitting and standing) was lower in the hens housed in the furnished cages than those in the battery cages ($P < 0.05$).

### Behaviors

The amount of time spent walking showed a treatment × age interaction. The birds housed in battery cages spent more time walking than those housed in furnished cages at 30 wk of age (Table 2, $P < 0.001$). In battery cages, walking was gradually reduced between 30 to 50 wk of age ($P < 0.05$), whereas walking was not changed in the birds housed in furnished cages ($P > 0.05$). In contrast, the birds in furnished cages spent more time feeding than those housed in battery cages, especially at 30 and 40 wk of age ($P < 0.05$ and 0.01, respectively).

Drinking behavior was significantly affected by age, with the birds housed in the furnished cages showing decreased time spent drinking at 40 wk of age ($P < 0.05$). There was no significant difference by treatment ($P > 0.05$). At 50 wk of age, the level of preening behavior was higher in the birds housed in furnished cages ($P < 0.05$), whereas the hens housed in battery cages spent more time performing exploratory pecking ($P < 0.05$).

Performance of dustbathing or sham dustbathing was not observed in the birds housed either in furnished or battery cages. In furnished cages, the birds performed exploratory pecking, resting, and preening behaviors in the dustbath area.

Behavioral transition index, recorded as the number of changes between behaviors, showed no significant differences between housing treatments at 30 or 40 wk of age ($P > 0.05$). However, the behavioral transition index was significantly increased from 40 to 50 wk of age in the birds housed in the battery cages compared with those housed in the furnished cages ($P < 0.01$).

### Furnishing Utilization

Perches, nestboxes, and dustbaths were provided only to the birds housed in the furnished cages. The hens spent a great amount of time on the perches (Figure 1),

**Table 2.** Effects of housing conditions, battery cages versus furnished cages, on various behaviors in laying hens[1]

| | Battery cages | | | Furnished cages | | |
|---|---|---|---|---|---|---|
| Behavior | 30 wk | 40 wk | 50 wk | 30 wk | 40 wk | 50 wk |
| Feed | $28.4 \pm 4.7^{a,B}$ | $16.5 \pm 3.4^{b,C}$ | $23.4 \pm 6.3^{ab}$ | $42.8 \pm 5.8^{A}$ | $35.1 \pm 6.1^{A}$ | $33.7 \pm 6.8$ |
| Drink | $8.0 \pm 1.8$ | $7.7 \pm 3.0$ | $8.1 \pm 2.1$ | $12.7 \pm 3.2^{a}$ | $4.3 \pm 0.6^{b}$ | $8.6 \pm 2.1^{ab}$ |
| Walk | $24.7 \pm 3.7^{a,A}$ | $15.6 \pm 3.8^{ab}$ | $10.5 \pm 1.5^{b}$ | $8.6 \pm 1.1^{C}$ | $13.2 \pm 2.8$ | $8.0 \pm 2.7$ |
| Preen | $18.9 \pm 4.4$ | $16.9 \pm 3.8$ | $10.5 \pm 2.2^{B}$ | $20.8 \pm 6.9$ | $13.4 \pm 4.7$ | $17.8 \pm 2.1^{A}$ |
| Exploratory pecking | $3.3 \pm 1.9^{b}$ | $1.7 \pm 1.3^{b}$ | $7.5 \pm 0.9^{a,A}$ | $2.2 \pm 1.5$ | $1.5 \pm 0.8$ | $2.2 \pm 1.2^{B}$ |
| Behavior transition index | $33.5 \pm 2.7$ | $25.6 \pm 4.2$ | $102.8 \pm 7.9^{A}$ | $29.7 \pm 3.3$ | $30.3 \pm 3.1$ | $55.5 \pm 13.5^{C}$ |

$^{a,b}$Significant difference seen within the same housing treatment ($P < 0.05$).

$^{A,B;\,A,C}$Significant difference seen between the battery and furnished cage systems ($^{A,B}P < 0.05$; $^{A,C}P < 0.01$).

[1]Data are presented as mean ± SE (n = 12).

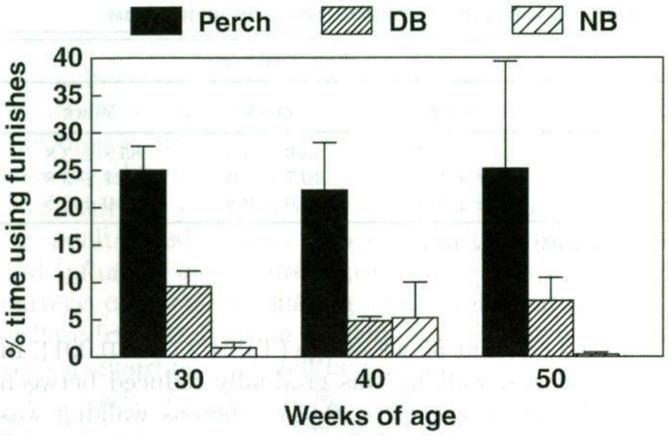


**Figure 1.** The percentage of time spent utilizing facilities of the birds' house in furnished cages. There were no age effects on birds using perches (Perch), the nestbox (NB), and dustbathing area (DB) during the observation time used in the study. Data are presented as mean ± SE.

and the dustbath area was occupied approximately 5% of the observation time. There were no significant differences in utilization of facilities among observed ages (i.e., 30, 40, and 50 wk of age; $P > 0.05$).

## DISCUSSION

### *Furnishing Usage*

Perches, nestboxes, and dustbaths were utilized by the birds throughout the first cycle of lay, indicating that the birds may consider that the facilities are important, especially the perches. A similar finding was reported in several studies (Braastad, 1990; Appleby et al., 1993). In those studies, birds spent 25 to 41% of the daytime on perches. However, birds are more willing to spend time on perches at night. Appleby (1998) reported that more than 80% of birds perched at night. In another study, using modified conventional battery cages with perches, Duncan et al. (1992) found that up to 99% of birds perched during the night. The birds' utilization of perches could be an inherent behavior because birds use branches of trees for resting in nature. This hypothesis is supported by Hoppitt et al. (2007). In these studies, the authors reported that bird response to facilitation is unlikely to be a social learning process. Bird well-being, at least in this portion, could be improved by providing perches to meet their natural behavioral needs (Hoppitt et al., 2007), to utilize the extra space (Weeks and Nicol, 2006), or to avoid interactions with more aggressive birds (Appleby and Hughes, 1991), or all three. In addition, the provision of perches allows for mechanical loading of the birds' skeleton, which maintains their strength during the lay cycle. In agreement with this hypothesis, Kopka et al. (2003) reported that the birds housed in furnished cages had better bone density than those housed in battery cages.

Prelaying behavior and the percentage of eggs laid in the nestbox was not observed in this study because of its limitations of design. There is huge evidence that the nestbox is very important to birds during egg laying. Yue and Duncan (2003) reported that, compared with the birds provided with a nestbox, the birds without a nestbox exhibited frustration behavior, stereotyped pacing. Cooper and Appleby (2003) indicated that birds are highly motivated to search a nestbox for laying. Birds displayed a great conservatism in nest site selection during various preference tests (Bubier, 1996; Cooper and Appleby, 2003; Zupan et al., 2008).

In furnished cages, the birds performed exploratory pecking, resting, and preening behaviors rather than dustbathing in the dustbath area. These results were similar to the findings of Lindberg and Nicol (1997) and those reported by Appleby et al. (2002). In these studies, the birds performed foraging, resting, and standing alert behaviors in the dustbath rather than dustbathing behavior. Domestic birds, such as White Leghorn W-36, have been highly selected for egg production in the battery caging systems (Hy-Line International, 2006). This may lead birds to adapt to the production environment with reduced dustbathing behavior when compared with birds in natural environments. In a motivational study of dustbathing behavior, Widowski and Duncan (2000) found that chickens were not willing to work harder when they were in a state of deprivation of dustbath compared with those that had recently dustbathed. The findings were explained as an opportunity model of motivation, performing the behavior when the opportunity presented, rather than a needs model of motivation, leading to a state of suffering by the deprivation. Windowski and Hemsworth (2008) also reported that birds did not show frustration when substrate for dustbathing was deprived. Therefore, increasing space available by providing a dustbath area may increase performance of other comfortable behaviors, such as pecking and preening, rather than dustbathing. In addition, dustbathing behavior could be affected by multiple factors, such as composition and amount of the dustbathing substrates (Moesta et al., 2008). A well-designed study is needed to functionally and motivationally analyze birds' natural behaviors, including dustbathing behavior.

### *Housing Environmental Effects on Bird Behavior*

Frequent changes in behaviors, which were seen in this experiment, have been shown to be indicative of restlessness, a stress indicator, in previous studies in humans and rodents (Koba et al., 2001; Schneider et al., 2006). Similarly, Johnson et al. (1998) reported that cage-housed hens have been shown to have increased posture transitions over aviary-housed hens. Similar to those findings, at 50 wk of age, the birds housed in battery cages had significantly higher levels of behavioral transitions than those housed in furnished cages (Table 2). In addition, at 30 wk of age, the birds housed in furnished cages showed significantly more time spent standing, whereas the birds housed in battery cages were shown to spend more time sitting on the cage floor (Table 1). Similar to the current results, turkeys housed in furnished cages had increased latency to sit when compared with ones housed without furnishings. This increased latency to sit may indicate better muscular-skeletal function (Maxwell, 1993). In the current study, provision of perches may also have benefited birds housed in furnished cages skeletally and behaviorally, therefore altering their behaviors.

Previous studies have shown that housing environments affect bird's eating behavior. Johnson et al. (1998) reported that cage-housed hens have been shown to spend more time feeding than aviary-housed hens. The current study revealed that overall, especially at 30 and 40 wk of age, the birds housed in furnished cages were shown to spend significantly more time feeding than the birds housed in battery cages (Table 2). High levels of feeding behavior in furnished housed birds may be correlated with their heavier BW (Pohle, 2007). A possible explanation for this increased feeding behavior is that feed trough space was sufficient to allow all birds to feed simultaneously, therefore encouraging group feeding. Feeder space effects on eating behavior and feed efficiency need to be further examined.

At 50 wk of age, preening behavior was significantly higher in the birds housed in furnished cages compared with those housed in battery cages (Table 2). Preening is considered a comfort behavior, which decreases when a bird is stressed (Duncan and Wood-Gush, 1972). Higher levels of preening in furnished cage-housed birds may indicate that they are experiencing lower levels of stress than the battery cage-housed birds. However, other studies indicate that increased preening could be associated with exposure to stress that is short-term and mild in intensity (Duncan and Wood-Gush, 1972; Elston et al, 2000). Further studies may be needed to examine if the increased levels of displaced preening are associated with reduced stress levels in poultry.

Compared with the birds housed in furnished cages, the birds housed in battery cages had higher levels of walking at 30 wk of age (Table 2) and spent more time exploratory pecking at 50 wk of age. Changes in these parameters, such as higher levels of active behaviors (walking and exploratory pecking) and repetitive bouts of pecking, have been found to be associated with stress in poultry (Duncan and Wood-Gush, 1972; Wechsler et al., 1997; Elston et. al., 2000).

In conclusion, higher levels of comfort behaviors expressed by the birds housed in furnished cages contrast with the higher levels of restless behavior in the birds housed in battery cages. This suggests that from an animal welfare point of view, the furnished cages may be a favorable alternative system for battery cages in housing birds for egg production. However, further studies are needed to examine mechanisms underlying birds' comfort behaviors and associated changes in stress-associated neurohormones.

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